

PALEONTOLOGICAL NOTE

## A silicoflagellate from the middle Albian of Austral Basin, Argentina

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**ABSTRACT.** Calcareous nannofossil biostratigraphic investigations of Cretaceous sediments within the southern high latitude Austral Basin, Argentina, have revealed the presence of a fragment of a silicoflagellate possibly belonging to the species *Variramus aculeifera* (Deflandre) McCartney, Wise, Harwood and Gersonde. Although only a fragment was identified in the samples examined from this locality, its presence is important, as it is only the second documented occurrence of an Early Cretaceous silicoflagellate. The specimen was found in a subsurface sample from the informal Palermo Aike Formation at Austral Basin. This stratigraphic level is interpreted as middle Albian on the basis of calcareous nannofossil biostratigraphy. The specimen consists of a fragmented strut with broken spines at the base, which allows the observation of the hollow skeletal structure. The strut is curved and slightly expanded at the widest part, which are characteristics diagnostic of the genus *Variramus*.

*Keywords:* *Variramus*, Albian, Austral Basin, Argentina.

**RESUMEN.** Un silicoflagelado en el Albiano medio de la Cuenca Austral, Argentina. Estudios sobre nanofósiles calcáreos en sedimentitas cretácicas de la Cuenca Austral, Argentina, revelaron la presencia de un fragmento de un silicoflagelado, posiblemente de *Variramus aculeifera* (Deflandre) McCartney, Wise, Harwood and Gersonde. A pesar de que se recuperó solo un fragmento, su presencia es importante porque representa el segundo registro de silicoflagelados del Cretácico Temprano. El espécimen fue hallado en una muestra de subsuelo correspondiente a la Formación Palermo Aike, en la Cuenca Austral. Ese nivel estratigráfico fue interpretado como Albiano medio sobre la base de los nanofósiles calcáreos. El ejemplar corresponde al fragmento de una barra con espinas rotas en la base, que permitieron observar la naturaleza hueca del esqueleto silíceo. La barra es curva y presenta un leve ensanchamiento, dos características diagnósticas del género *Variramus*.

*Palabras clave:* *Variramus*, Albiano, Cuenca Austral, Argentina.

1. Introduction

Calcareous nannofossil biostratigraphic investigations of Cretaceous sediments within the southern high latitude Austral Basin, Argentina (Pérez-Panera, 2012), have revealed the presence of a fragment of a Cretaceous silicoflagellate possibly related to the species *Variramus aculeifera* (Deflandre, 1950). Silicoflagellates are almost unknown from Lower Cretaceous sediments, so even though

this is a single fragment, it is important because it is only the second documented occurrence of an Early Cretaceous silicoflagellate in the world (McCartney, 2013). The specimen comes from a middle Albian sample from Cañadón Salto borehole, Austral Basin, Argentina. The investigated samples were provided by Petrobras-Energía S.A. and the name and location of the borehole are confidential; however, figure 1 illustrates its general location within the Austral Basin.

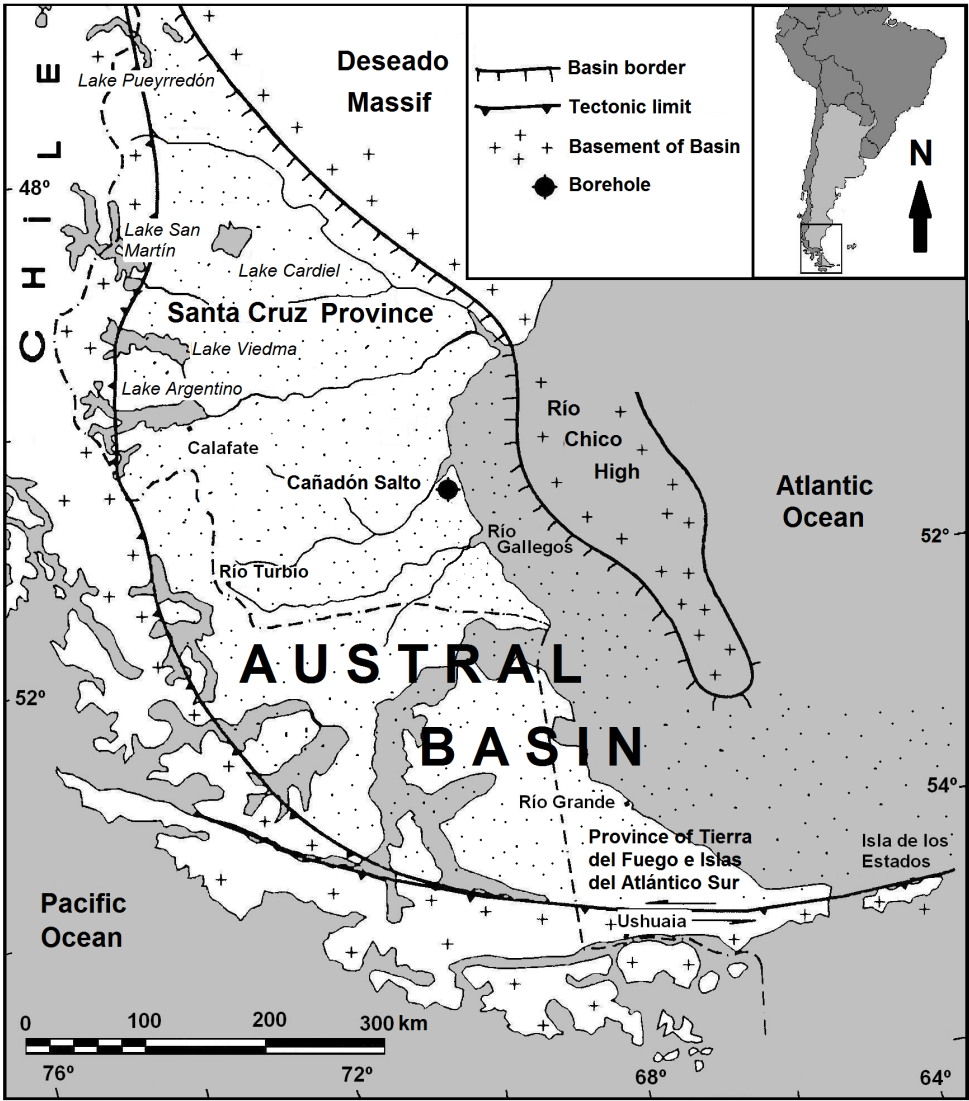


FIG. 1. Location map of Cañadón Salto Borehole, Austral Basin, Argentina.

## 2. Materials and Methods

The sample was prepared according to the gravity settling technique of Bramlette and Sullivan (1961), originally for calcareous nannofossil analysis. A FEI Quanta 200 Scanning Electron Microscope was used for sample examination and photographs. In order to evaluate the composition of both the matrix and the silicoflagellate, an EDX analysis was completed (Fig. 2), confirming the siliceous composition of the specimen. The sample is deposited in the Museo de La Plata nannopaleontological collection under number MLP-NC 0001.

## 3. Stratigraphic provenance

The specimen was recovered from a subsurface sample at 1,200-1,209 m sub-bottom depth (msbd) in the informal Palermo Aike Formation at Austral Basin. This stratigraphic level is interpreted as middle Albian based on calcareous nannofossil biostratigraphy (Pérez-Panera, 2012). The interval between 1,191-1,200 and 1,350-1,352 msbd is correlated with the early to middle Albian Zone CC8 of Sissingh (1977) and the *Rhagodiscus asper* and *Sollasites falklandensis* Subzones of Wise (1988). More precisely, the last occurrence of *S. falklandensis*

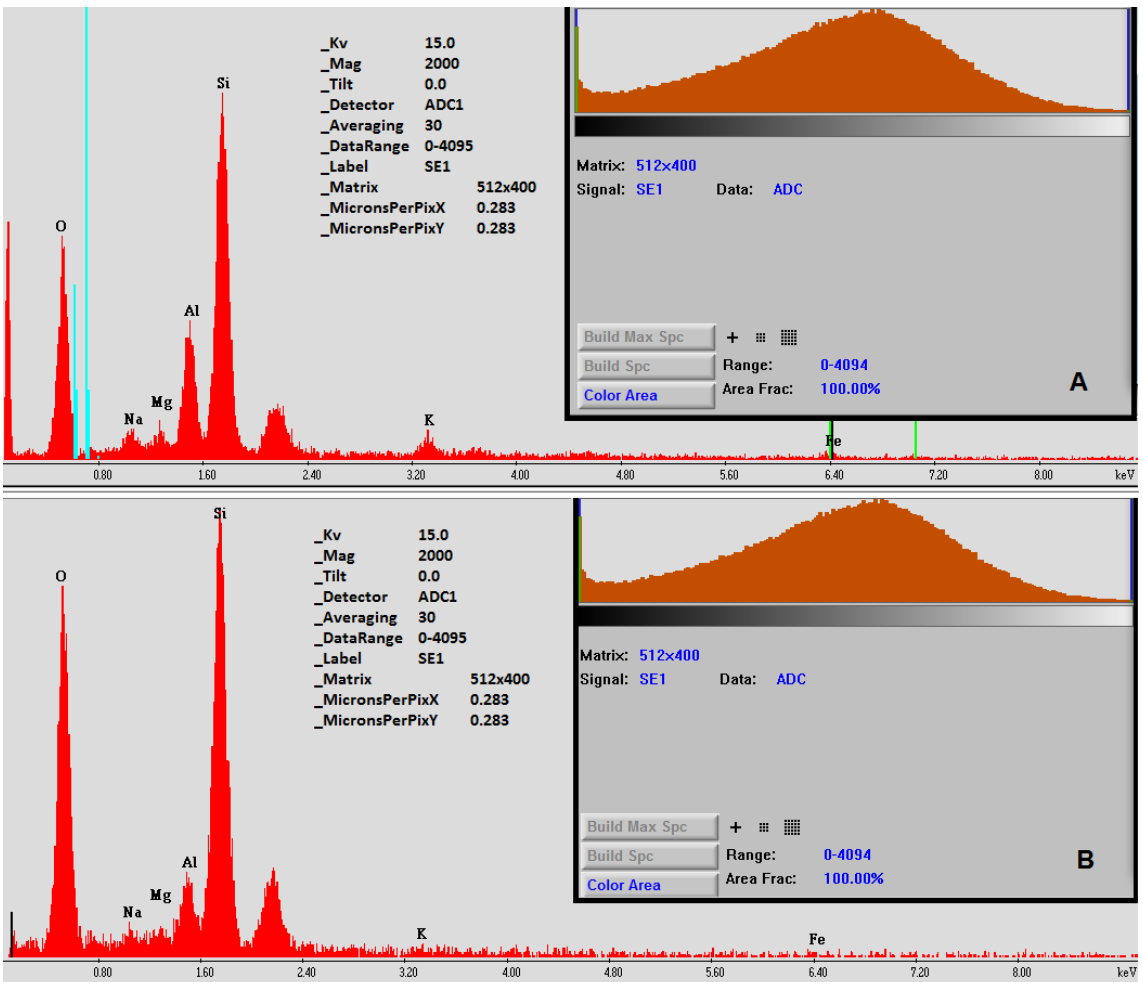


FIG. 2. Comparison of EDX analysis for the sediment (A) and for the silicoflagellate specimen (B). Note the differences between the silica (Si) and oxygen (O) peaks, which are higher for the silicoflagellate (b), illustrating the opaline nature of its skeleton.

is identified in sample 1,191-1,200 msbd, just above the sample where the silicoflagellate specimen occurs. Thus, on the basis of calcareous nannofossil biostratigraphy, it is possible to constrain the age of the sample containing the silicoflagellate to the middle Albian (Pérez-Panera, 2011).

#### 4. Systematic Palaeontology

Division OCHROPHYTA Cavalier-Smith, 1995

Class DICTYOCOPHYCEAE Silva, 1980

Order DICTYOCHELES Haeckel, 1894

Family DICTYOCHEACEAE Lemmermann, 1901

**Genus:** *Variramus* McCartney, Wise, Harwood and Gersonde, 1990

**Type species:** *Variramus aculeifera* (Deflandre, 1950) McCartney, Wise, Harwood and Gersonde, 1990.

*Variramus* sp. aff. *Variramus aculeifera* (Deflandre, 1950) McCartney, Wise, Harwood and Gersonde, 1990 (Fig.3).

**Description.** The recovered specimen consists of a fragmented strut with broken spines at the base, which allows observation of its hollow skeletal structure. The strut is curved and slightly expanded at its widest part, which are diagnostic characteristics of the genus *Variramus*. It is possible to recognize the base of three spines that are oriented in two different planes. The end of the strut attaches to a basal spine, which is obscured by the surrounding clay matrix, but it is possible to identify the structure as a spine based on its tapered appearance. The opposite end of the strut is broken, possibly at the point where it connects with the bridge. Although this specimen is only a small fragment of the entire individual, it is here compared to *Variramus aculeifera* based on the curved and expanded strut and the slightly displaced triple joint at the end, which resembles a sabaton. This specimen looks very similar to the specimen illustrated in plate 3, figures 4 and 5, and to the ends of the specimens in plate 2, figures 5 and 8 of McCartney *et al.* (1990).



FIG. 3. *Variramus* sp. aff. *V. aculeifera* (Deflandre, 1950) McCartney, Wise, Harwood and Gersonde, 1990. Cañadón Salto Borehole 1200-1209 msbd. MLP-NC 0001.

**Known stratigraphic and geographic range.** Early to middle Albian of Weddell Sea, Antarctica, Ocean Drilling Program (ODP) Site 693 (McCartney and Wise, 1988; McCartney *et al.*, 1990, 2014); Santonian-Campanian of Canadian archipelago, Arctic Ocean (McCartney *et al.*, 2011a, 2011b). Unconfirmed record from the Maastrichtian of California (Deflandre, 1950; Tsumura, 1963, age assignment may be wrong and could be older, see McCartney *et al.*, 1990, 2010, 2011a and McCartney, 2013 for discussion); Campanian-Maastrichtian of Southwest Pacific Ocean, Deep Sea Drilling Project (DSDP) Site 275, (Bukry, 1975); Campanian-Maastrichtian of Arctic Ocean, Alpha Ridge (Bukry, 1981, 1985), Campanian-Maastrichtian of Tonga Trench, Pacific Ocean (Quinterio *et al.*, 1994).

**Dimensions of the specimen.** Length: 12.5 µm; width: 1.6 to 2.0 µm.

**Provenance.** Austral Basin, Cañadón Salto borehole, 1200-1209 msbd, middle Albian.

## 5. Discussion

The origin and evolutionary history of silicoflagellates during the Cretaceous is an interesting but poorly understood subject. In the last two decades, important advances had been made (McCartney, 2013; McCartney and Wise, 1988; McCartney *et al.*, 1990, 2010, 2011a, 2011b, 2014), but questions still remain. McCartney *et al.* (1990) documented an abundant and diverse silicoflagellate assemblage from the lower to middle Albian of the Weddell Sea, indicating an older origin for the group than previously documented. In subsequent studies, McCartney *et al.*, (2010, 2014) demonstrated that this Weddell Sea assemblage is even more diverse than previously thought and includes a variety of species and morphologies assigned to four Albian genera: *Gleserocha*, *Schulzyocha*, *Vallacerta* and *Variramus*. Recent studies (McCartney *et al.*, 2011a, 2011b, 2014) of upper Santonian-lower Campanian samples from the Canadian archipelago showed that silicoflagellates had experienced a radiation by that time, with the addition of five new genera: *Cornua*, *Umpiocha*, *Corbisema*, *Lyrarmula* and *Arctyochoa*. These localities contain the best-known Cretaceous silicoflagellate fossil records, and their discovery has led to a significant increase in our understanding of silicoflagellate evolution (McCartney, 2013; McCartney *et al.*, 2014). By the late Maastrichtian,

the oldest silicoflagellate lineages, with the exception of the genus *Vallacerta*, had become extinct. At the Cretaceous/Paleogene boundary, only *Corbisema* survived the extinction event, and this genus gave rise to all Cenozoic silicoflagellates (McCartney *et al.*, 2014).

Even though these recent advances have shed light on the origin and early evolution of the silicoflagellates, there are still important gaps in our knowledge. The geographic range of the Cretaceous silicoflagellate records is very small and limited to a few regions from the middle to high latitudes. Until now, the only Early Cretaceous silicoflagellates known were from ODP Site 693 (McCartney, 2013), which contains an early Albian moderately diverse assemblage of silicoflagellates. Silicoflagellates were more abundant and diverse by the late Santonian-early Campanian, but there is currently no known record spanning the Cenomanian to Coniacian. This scarcity of information for the early history of this group makes each new record of vital importance.

The identification of this specimen in a sample of middle Albian age from southern Patagonia represents the second record of a silicoflagellate of Early Cretaceous age, providing a new geographic region to look for clues about the evolution and diversification of this group.

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